Introduction and Status of the NuMI Project

Director's Review of Installation

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NuMI Project Manager
April 8, 2003

Outline

- Project overview
- Status
- Introduction to our Installation Plans
- Summary and Outlook

NuMI (**N**eutrinos at the **M**ain **I**njector)
MINOS (**M**ain **I**njector **N**eutrino **O**scillation **S**earch)

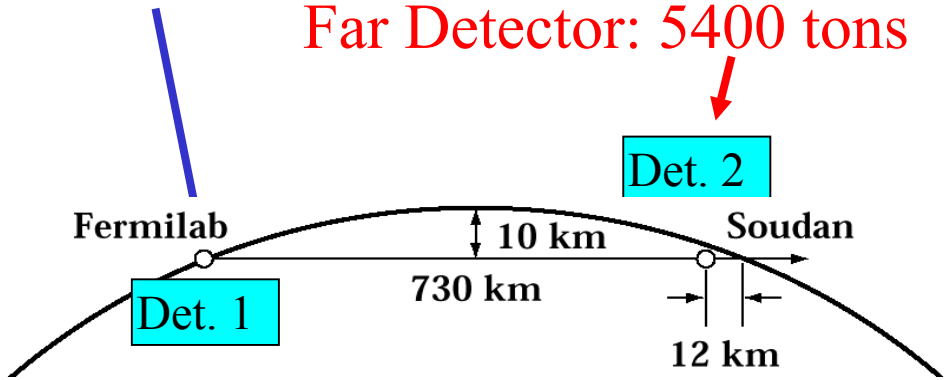
NuMI Project

Construct Facilities and Equipment for a Two Detector Neutrino Oscillation Experiment with Variable Energy Neutrino Beam (Start 2005)

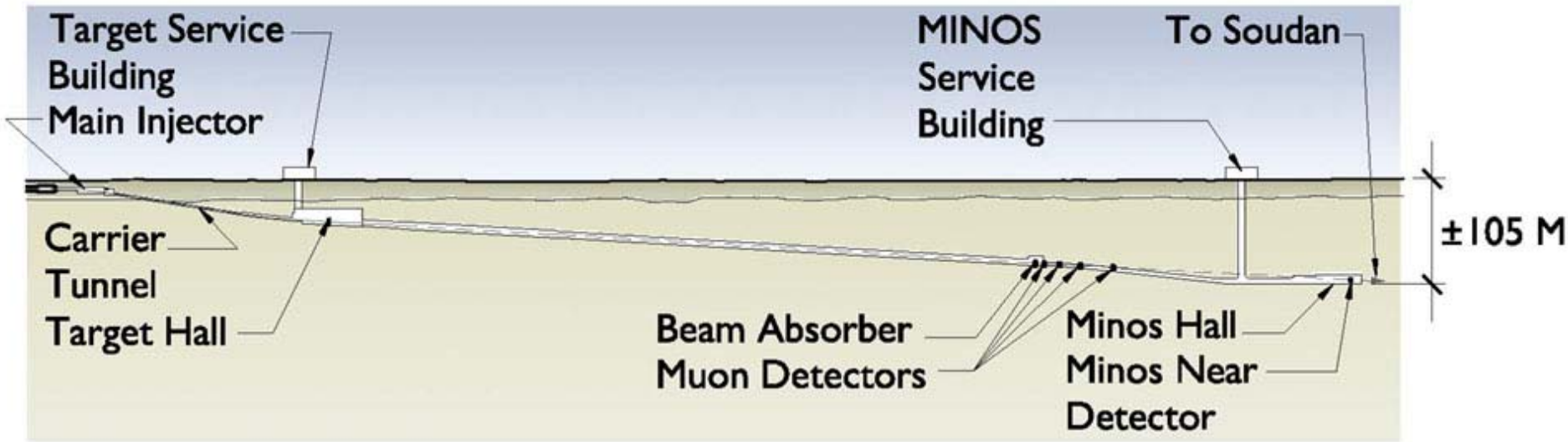
Obtain firm evidence for oscillations and measure oscillation parameters, Δm^2, $\sin^2 2\theta$. Probe for $\nu_\mu \rightarrow \nu_e$ appearance.

Near Detector: 980 tons

Far Detector: 5400 tons



NuMI Facilities at Fermilab



- Very large, complicated conventional construction
- **Three *major* installations in three *different* areas:**
  - Several hundred feet of accelerator enclosure—half of which is between two operating machines
  - Downstream end of carrier tunnel, Pre-Target and Target Areas--primary beam focus, 8KT neutrino beam
  - MINOS area—beam monitoring, ~1 KT hadron absorber and ~ 1 KT neutrino detector

NuMI Facilities at Fermilab

Extract beam from Main Injector (magnets, kickers)

Transport, focus 120 GeV proton beam (magnets, instrumentation, baffles)

Target (protons produce π^+) and radiation shielding

Magnetic horn to focus π^+, power supply, cooling water

Long evacuated pipe, π^+ decay to $\mu^+\nu$

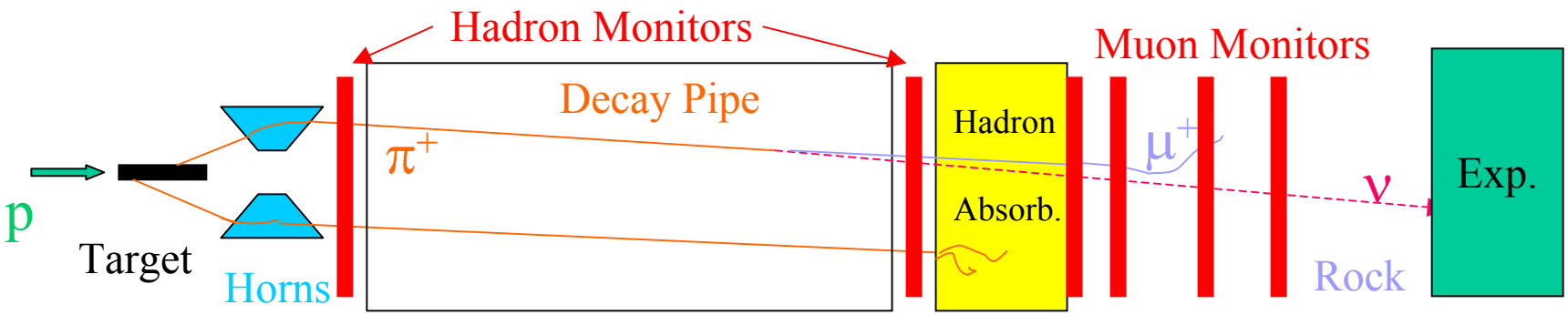
Left-over hadrons shower in hadron absorber

Rock shield ranges out μ^+

Detector chambers to monitor beam

ν beam travels through earth *to experiment*

Alignment, Integration



Progress Since Last March

- Conventional Construction
  - Excavation completed !
  - Service Buildings and Outfitting under contract and well underway
- Technical Components
  - Primary beam re-designed. All key design work is complete. Fabrication underway. Installation in progress. Starting to plan for commissioning and operations
- MINOS Detectors
  - First of 2 Far Detector SuperModules complete and recording atmospheric neutrino data. The second will be finished later this summer. Good progress on Near Detector. Calibration data taken.
- During the past year over $30M of progress. As of March 31, about $30M to go
- We remain on the plan--scope, cost, and schedule.

Technical Components

- Significant technical progress being made in all areas and milestones. Engineering levels ~ OK. Drafting taking more time than planned. Major designs complete. Costs holding constant since 2001.
- Primary Beam Design (Beamsheet) accepted by Main Injector.
- Technical Components Handbook V2.0 released.
- Internal assessment reviews continue.
- Fabrication of Neutrino Beam components on schedule with float and reasonable staffing. No changes being discussed.
- WE ARE GOING TO BE READY FOR ALL INSTALLATIONS AS PLANNED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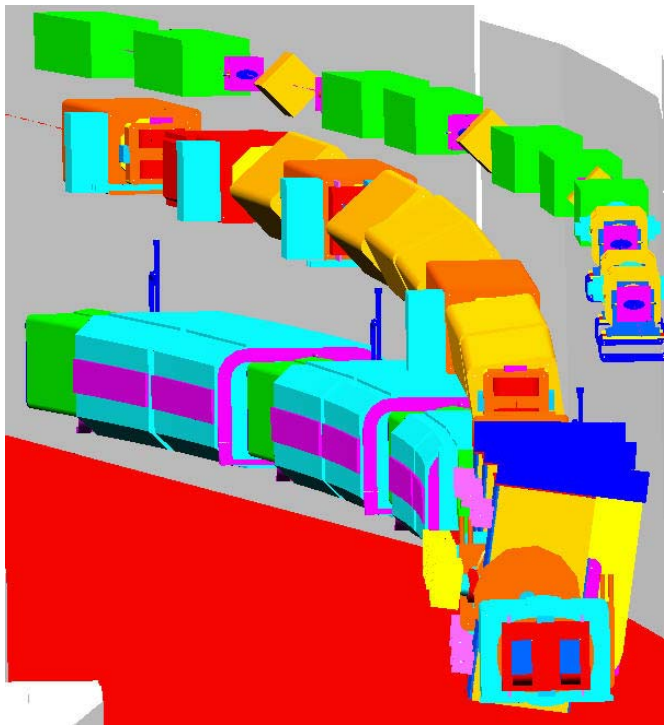
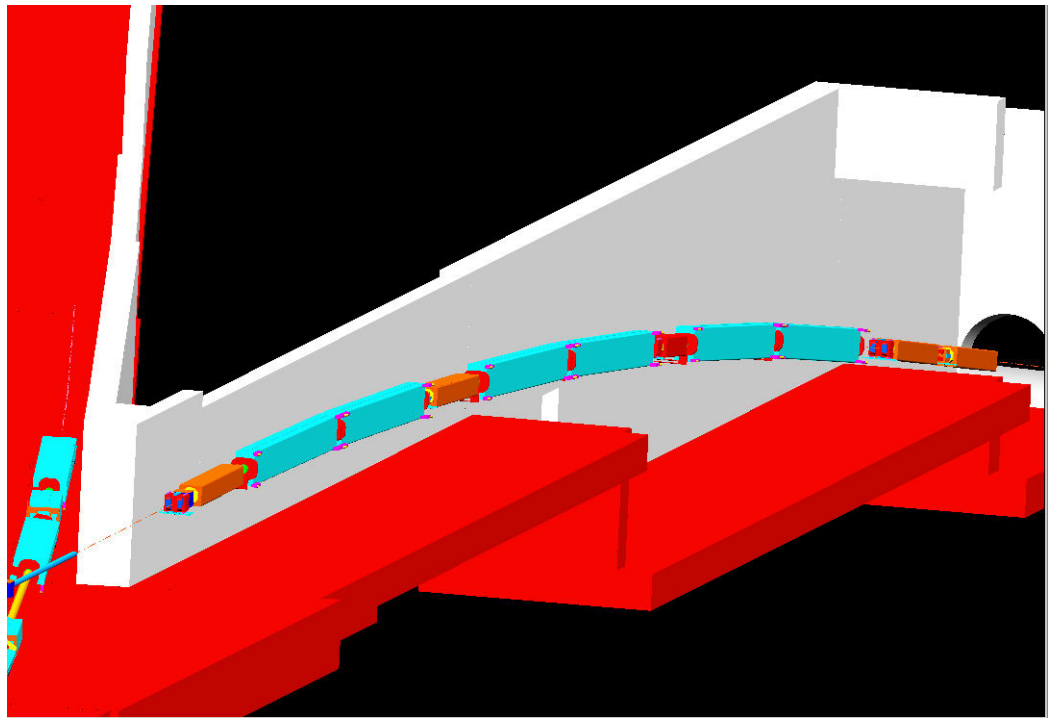
Installation Challenge: NuMI in the Main Injector Tunnel



MI ring on bottom, Recycler on top, NuMI in the middle
(fit between two accelerators)



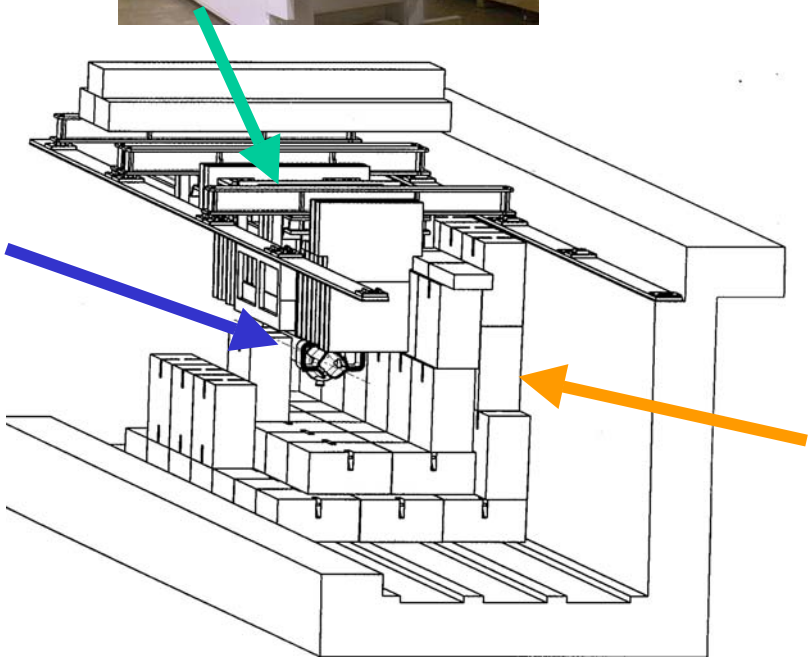
NuMI Stub and Extension
(needs cranes, utilities etc.)

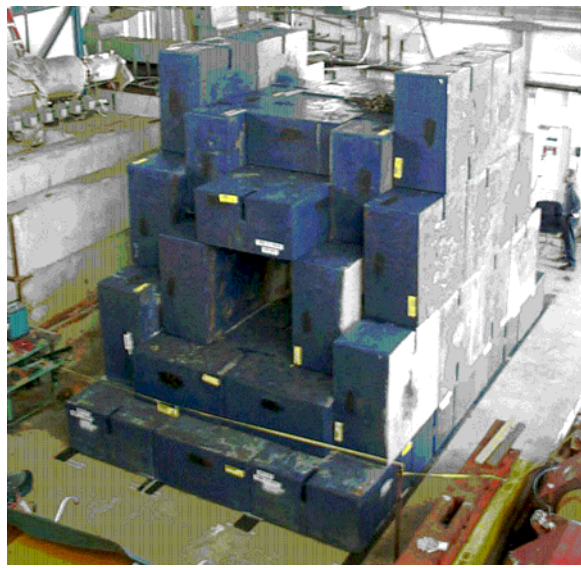
Target Hall Installation

(plus recirculating air cooling, target, hot work cell, etc 3X Pbar Target Pile size)

1 of three
27 ton support modules

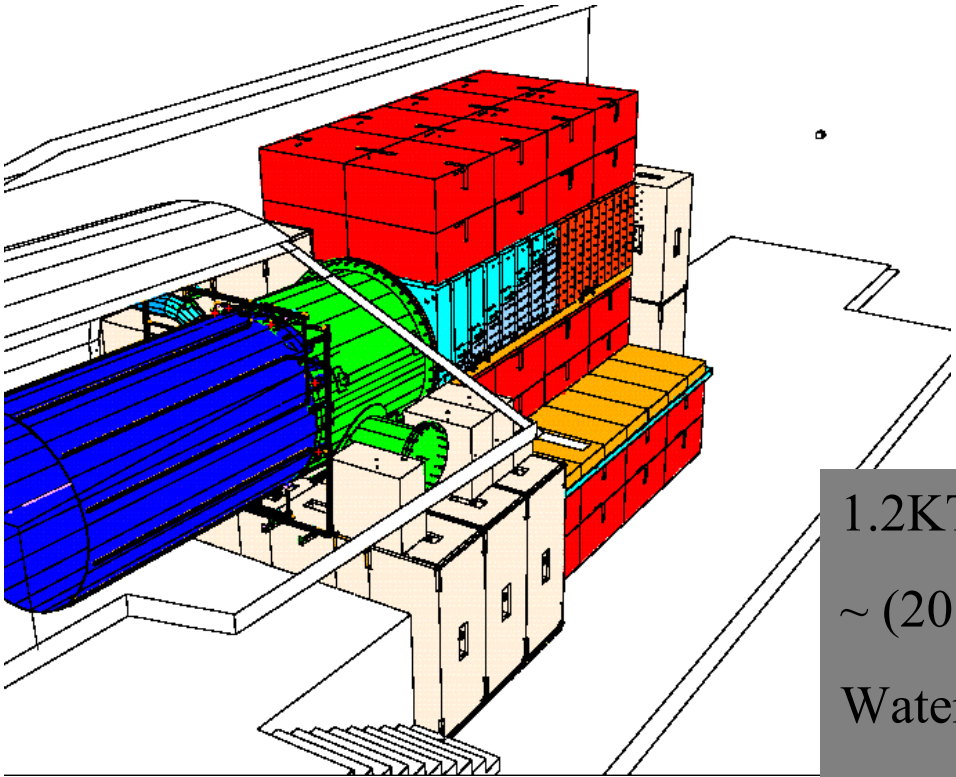
1 of two focusing horns





(10% of) Shielding Blocks

Hadron Absorber



120 KJoules of beam

100 KJ protons

15 KJ charged

5 KJ neutrals

70 KW

1.2KTons

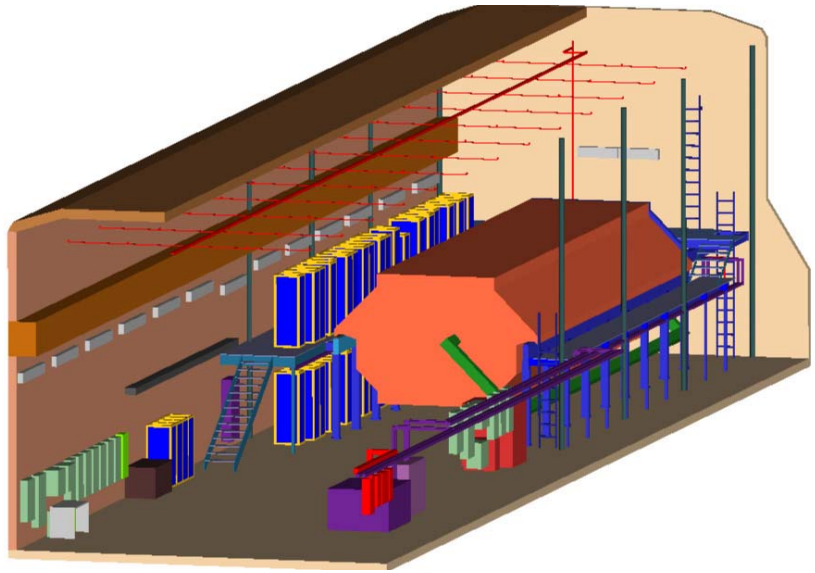
~ (20' X 20' X 35')

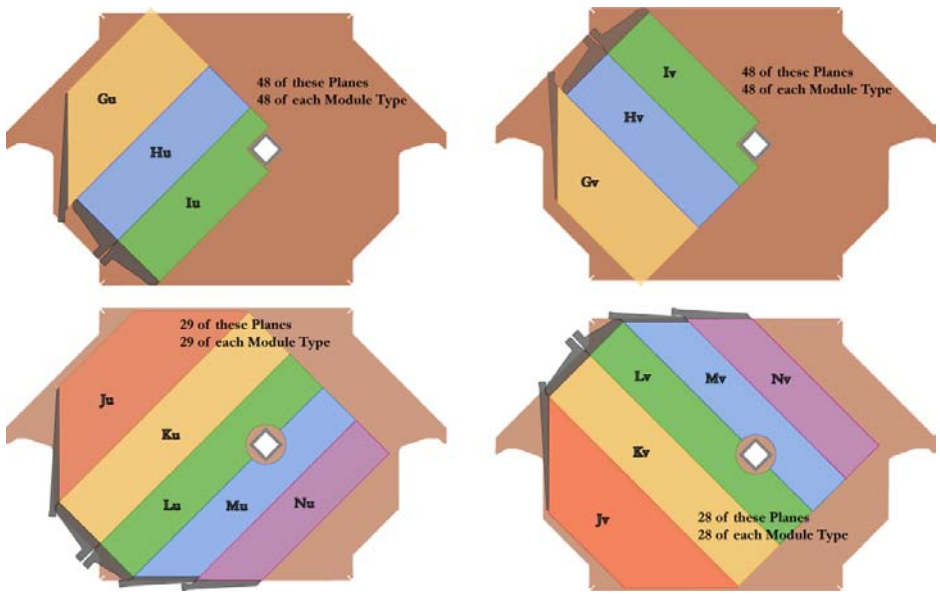
Water Cooled Al and Steel

Termination of 675m vacuum piple

Near Detector

- **3.8 x 4.8m** "octagonal" steel & scintillator tracking calorimeter
- Same basic construction, sampling and response as the far detector.
- **282 planes of steel w/153 planes of scintillator**
- **READY TO GO IN (see during tour)**

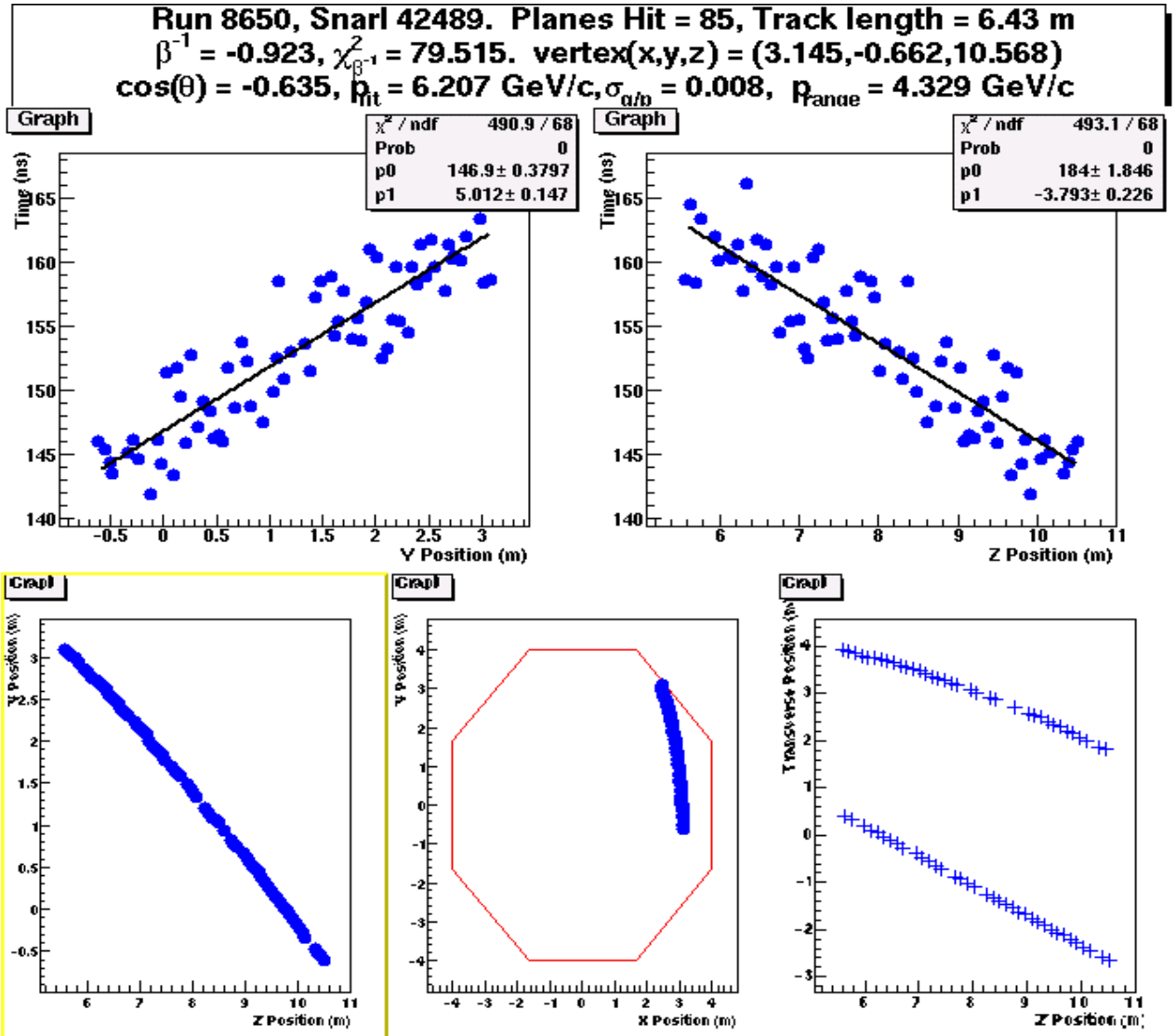




Far Detector Status

- Installed plane 426 (of 484).
- Installation end game being implemented. Factories shutting down.
- The B field has been turned on for the 1st Super Module and data are being recorded The current analysis is focusing on upward going μ's and ν interactions
- CALDET tests at CERN in 2002 (150 channels) and 2003 (1500 channels) testing ND/FD electronics

Atmospheric Neutrino Interaction
(Waiting for Beam in Minnesota)



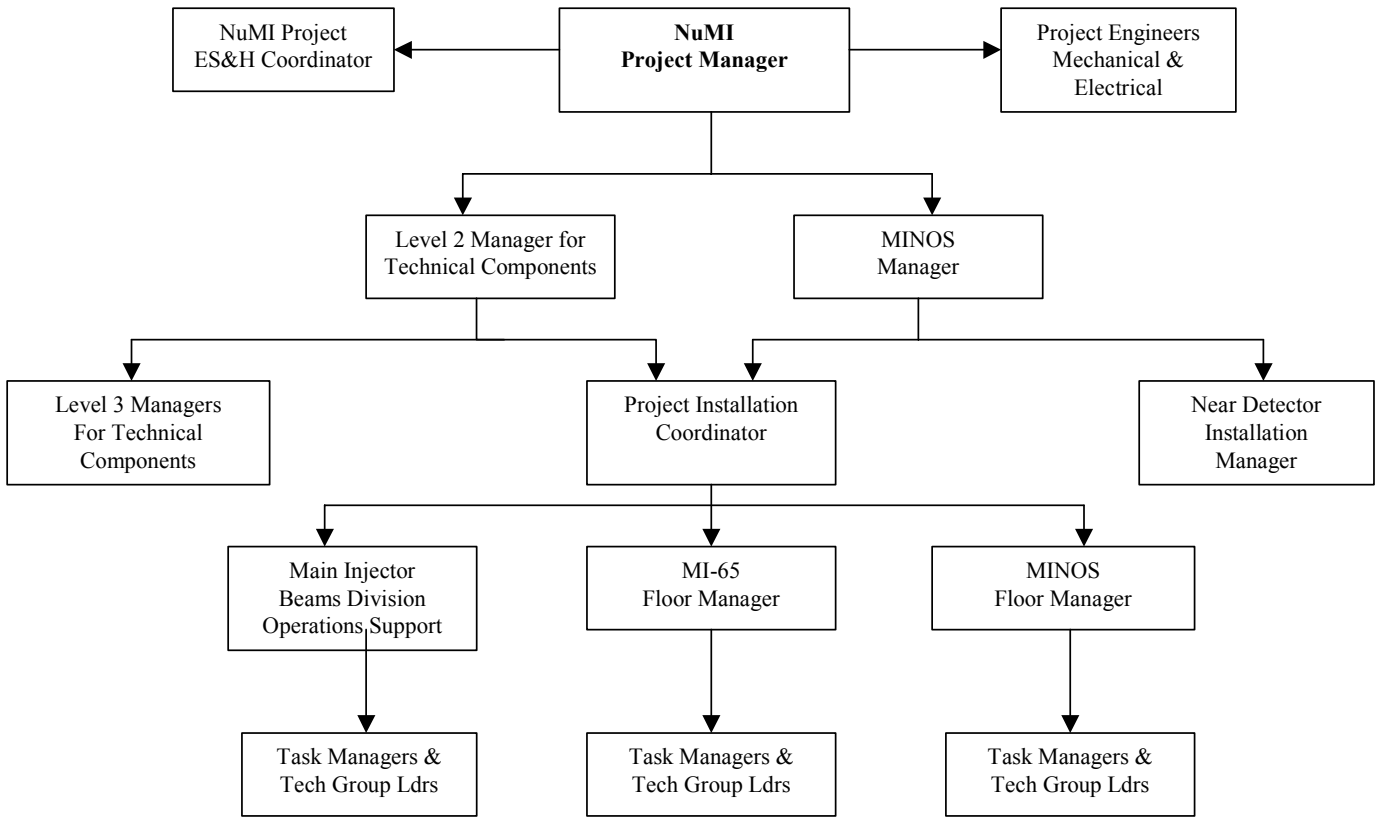
Environment, Safety and Health

- Safety across the project remains uppermost on all our minds. Deep underground facility unique at Fermilab.
- Our safety plan emphasizes Fermilab's safe work policies. Throughout the project we are taking time to plan ahead, identify hazards, put controls in place, monitor, assess, and correct.
- Take action when necessary. Six workers removed from SBO job for violations of safety procedures. Investigate incidents and implement appropriate corrective actions. To date, no injuries on the SBO job.
- Added ES&H staff to cover increase in activities for FY03. We will add more if needed as installation plans develop.
- Working on Shielding Assessment and SAD preparation for some time already. Goal is approval in April 04.
- Continuing to monitor Environmental compliance of our contractors. Water treatment plan in place.
- Beamline component ES&H reviews continue. Walkthroughs of Fermilab sites instituted.

NuMI Installation Management

- NuMI Project will manage the installation in the new facilities that will be transferred to Fermilab in the Fall. It will use a model similar to the one used successfully during the conventional construction. (This is consistent with the existing BD and PPD organizations for NuMI and MINOS).
- Transition to management of the facility during beam commissioning and actual operations will be worked out within a year. (6 months before beam)
- Working with BD and PPD to fill out the installation organization we set up last Fall: Leaders and technical staffs.

NuMI Installation Organization



Commissioning and Transition to Operations

- Commissioning Plan developed
  - Technical Components Managers
  - Concentration on CD4 goals
- Evolution to initial operational intensity
  - 2.5E13 protons , 5/6 batches, 5E12 in Booster , 1.9s cycle
  - Integration into BD/HQ planning underway: tasks, studies, schedule and people
  - Multi-batch studies, dampers, beam loading compensation, booster shielding, booster notch and timing, possible RF upgrades

December Review
"High Level Recommendations"

- Identify Floor Managers and Task Managers / Technical Group Leaders ASAP for input into installation planning
  - « Added people, discussions underway, remains critical: needed by June
- Provide total project installation schedule showing primary (and near) critical path(s)
  - « Provided critical path, more info in upcoming talks/discussions
- Another Installation Review in March/April 2003
  - « Here we are in April
- Details of summer shutdown IP available
  - « Upcoming talks
- Update on balance of project IP
  - « Upcoming talks
- Judgment of SB&O (Service Buildings & Outfitting) contractor schedule performance
  - « Upcoming talks

Responses to Further Recommendations from the December Review

No	Responsible	Recommendation	Status - April 3, 2003
1	R. Andrews	Revise the Installation Coordination plan to define the mechanism & responsibilities for drafting contract	**Complete.** The plan has been updated.
2	Ducar	The list of Davis Bacon exempt tasks should be finalized and submitted to DOE for approval by March 31, 2003.	The Davis-Bacon determination document was submitted to Business Services Section on March 31, 2003.
3	Baller	The committee supports the plan to install Lambertson magnets in the summer 2003 shutdown, and encourages the project to get agreement from BD management as soon as	Beams Division management has decided to delay installation of the Lambertson magnets to the Summer 2004 shutdown.
4	R. Andrews Childress	The committee would encourage the project to have the magnets in close proximity to the Recycler capable of being powered at the end of the 2003 summer shutdown (without water cooling would be acceptable) so that the magnets could be ramped to allow measurements of their impact on the	We plan to have all magnets ready for intermittent testing at the end of the summer 2003 shutdown.
5	M. Andrews	We recommend that the project review the charge to the NuMI safety review committee	The role of the NuMI safety review committee differs from safety review committees on other projects. Beams Division management is considering changes to the committee structure.
6	Grossman	The installation plans presented were based on the assumption that, following removal of the shield wall, access would be allowed from the midpoint of the carrier tunnel to the target hall during Main Injector operations. Calculations supporting this scenario are under preparation/review. This effort should be completed and the project should obtain ES&H Section approval.	**Complete.** The effort has been completed and a document, "MARS Simulation of MI Worst Case Accident Dose Rates in NuMI Carrier Tunnel", produced. It has been reviewed and approved by the ES&H Section.
7	Pushka	The dependence on cranes during the installation activity should warrant the investigation of preemptive maintenance and possible repair procedures (spare parts) to minimize downtime. This should pertain to the MINOS cranes as well.	**Complete.** The NuMI cranes are new and are rated for service exceeding their planned use. In the unlikely event the crane fails to operate during installation, we anticipate no more than a 1 week delay for repair. We deem the schedule risk minimal.
8	Bock +	Director's office demarcation of the PPD/BD boundary in the final NuMI facility	The basic plan is in place. Details are being worked out between NuMI/BD/PPD.

NuMI Schedule

- The critical path remains the completion of the civil construction at Fermilab and the subsequent installation of the NuMI technical components.
- The schedule contains float. The schedule is integrated and resource loaded.Re-estimates of critical activities are underway with the goal of accelerating the project.
- We have been on schedule or slightly ahead for the past 21 months.

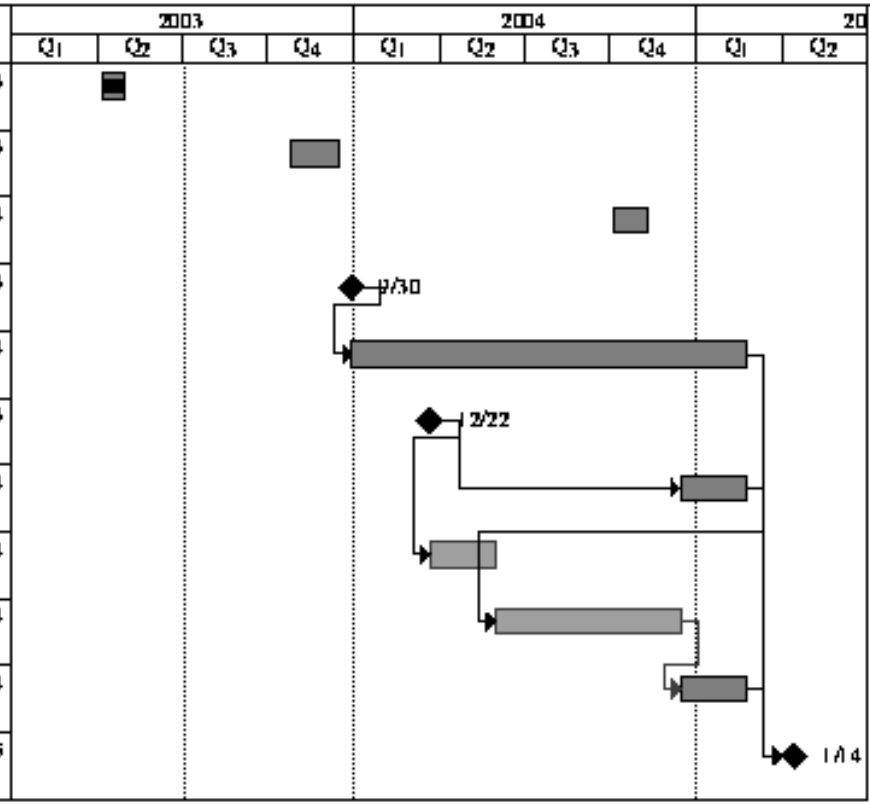
Project Schedule to Completion

Schedule

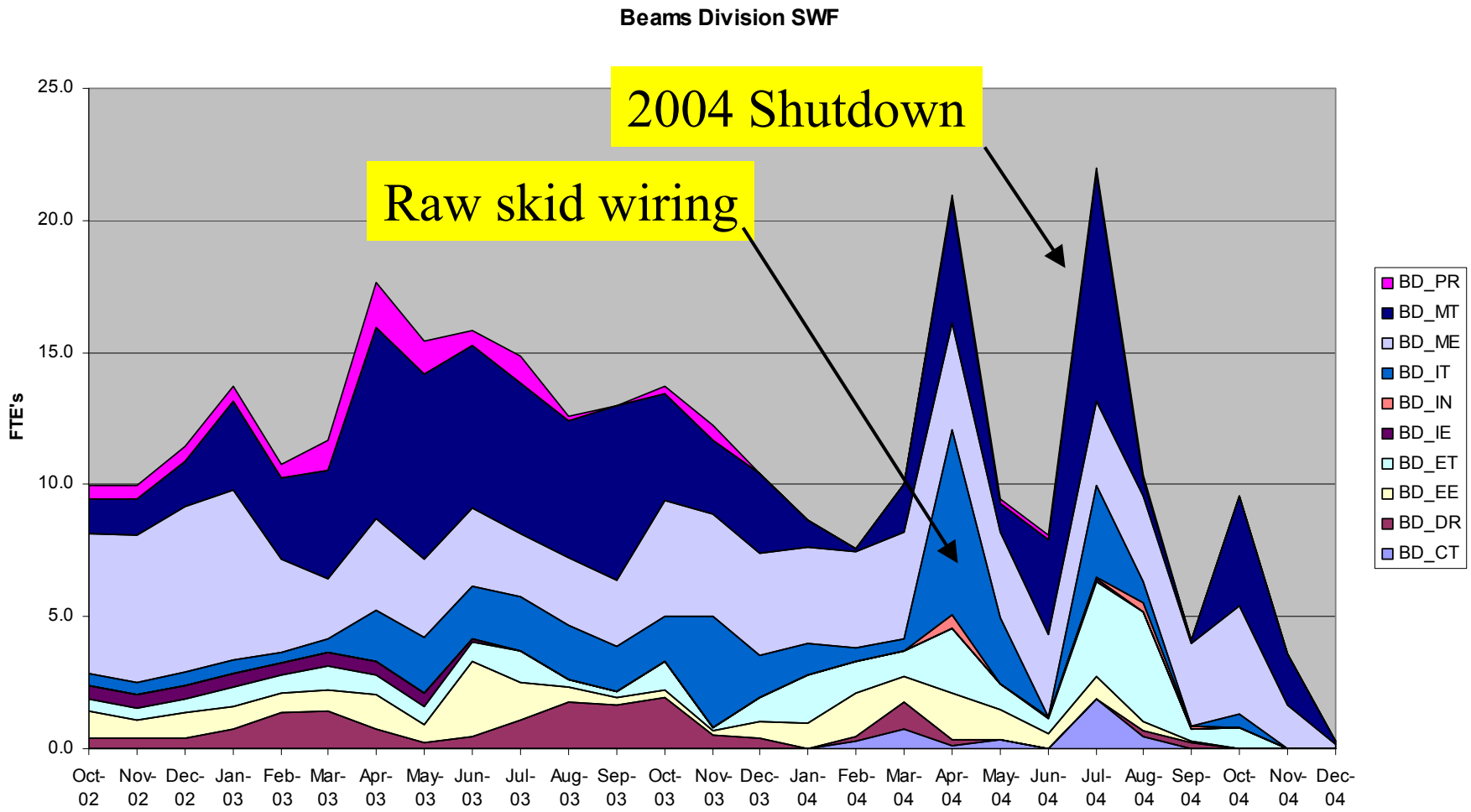
Installation Schedule
Overview

4/4/03

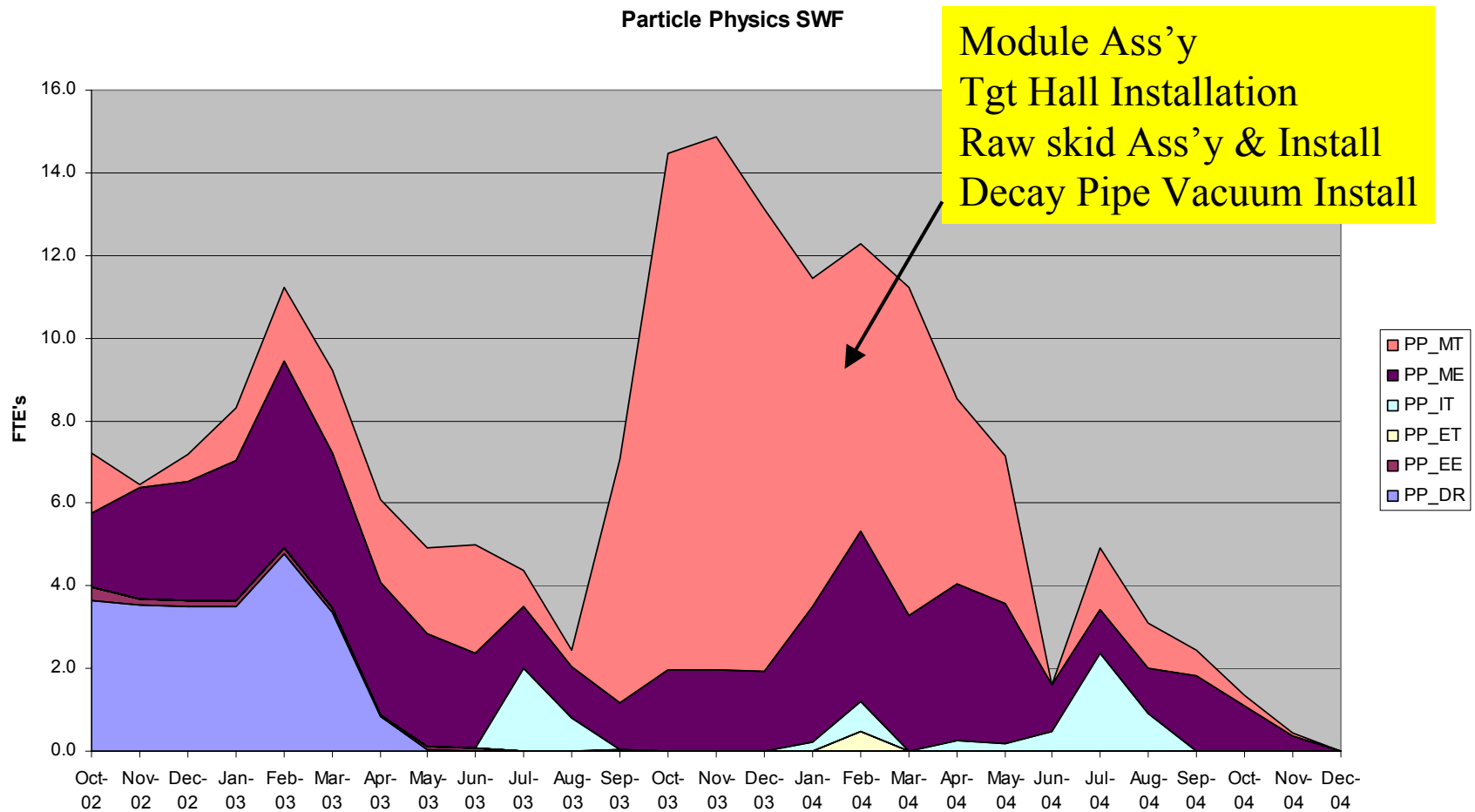
Task Name	Start	Finish
Shutdown for C 0 Lambertson Removal	1/7/03	1/30/03
2003 Summer Shutdown	7/28/03	9/15/03
2004 Summer Shutdown	7/5/04	8/11/04
Upstream Area Beneficial Occupancy	9/30/03	9/30/03
Target Hall nstallation & Pre target nstallation	9/30/03	11/24/04
Downstream Area Beneficial Occupancy	12/22/03	12/22/03
nstall decay pipe end cap, start absorber installation	9/14/04	11/24/04
nstall near detector utility work	12/22/03	3/1/04
Near Detector rigging	3/2/04	9/14/04
Finish absorber& labyrinth installation	9/15/04	11/24/04
Commission Technical Components	1/14/05	1/14/05



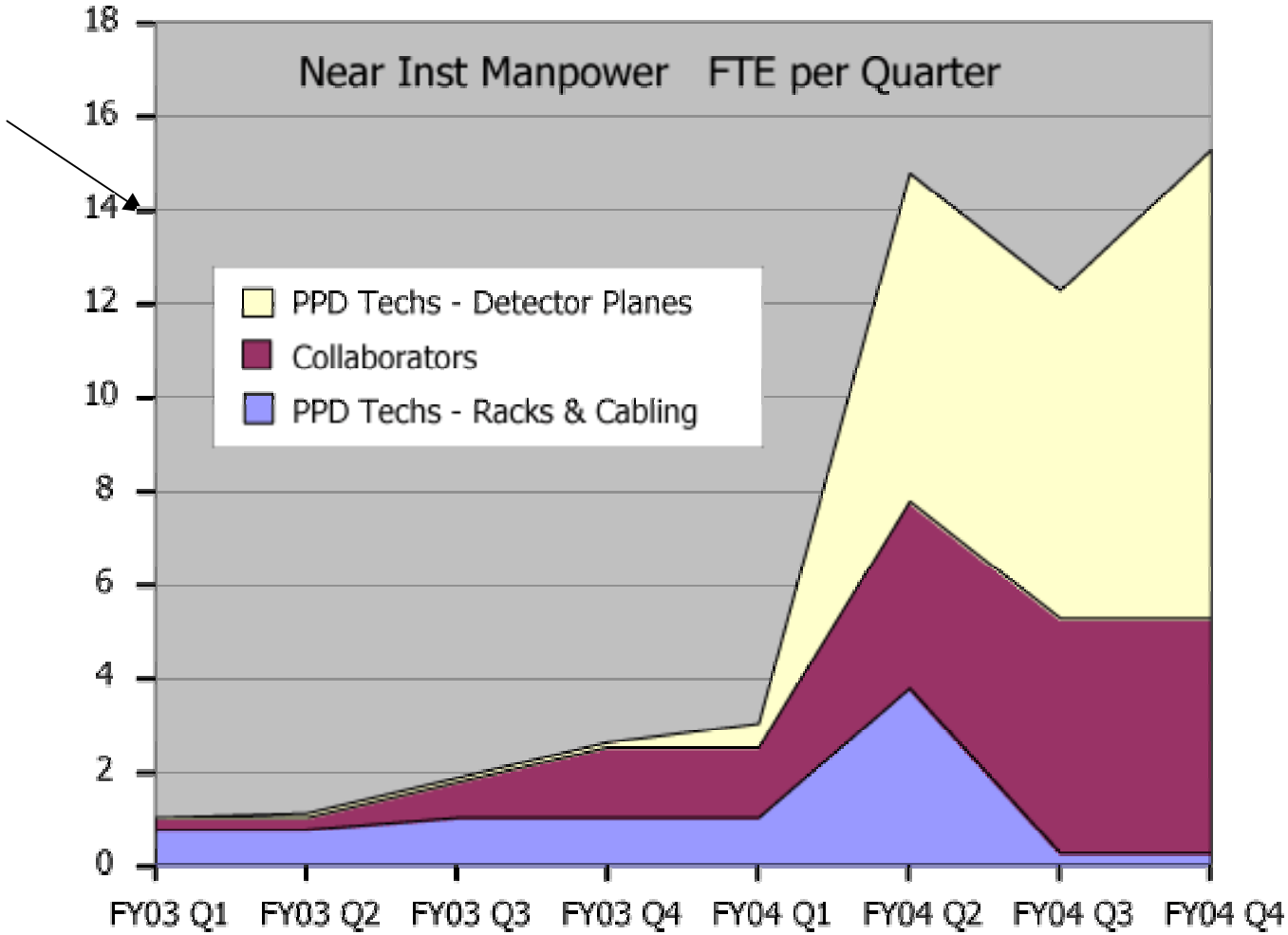
Technical Components Labor (BD)



Technical Components Labor (PPD)

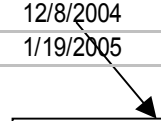


Near Detector Installation Labor (PPD + Collab)

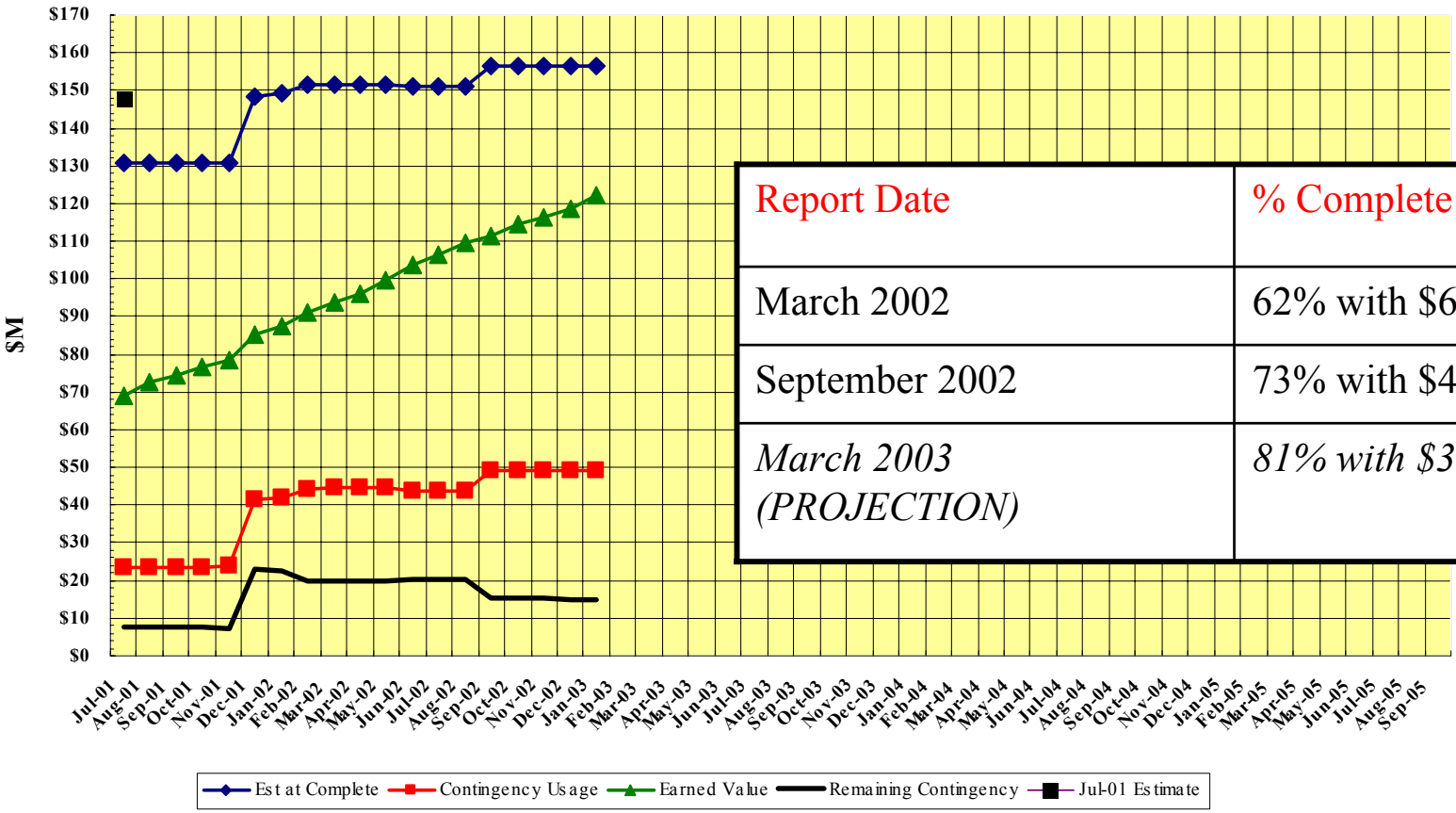


Doe Milestones FY2002-2005
(Shaded milestones completed since March 2002)

Milestone Description	PEP Milestone #	DOE Milestones (As of 12/2001)	Current Month's Forecast Milestone	DOE Milestone Variance (Cal Days)	Notes
Cosmic Rays Observed in Far Detector	L-2-10	3/22/2002	8/31/2001	203	Complete
Technology Choice Made for Muon Monitors	L-2-16	5/30/2002	12/10/2001	171	Complete
Service Building & Outfitting Bid Package Out	L-1-10	7/30/2002	2/25/2002	155	Complete
75% Scintillator Produced	L-2-19	8/30/2002	5/24/2002	98	Complete
Near Detector Hall Excavation Complete	L-2-7	12/30/2002	8/30/2002	122	Complete
Target Hall Excavation Complete	L-1-5	12/30/2002	10/4/2002	87	Complete
Lambertson & C-Magnets Assembled & Tested	L-2-12	2/1/2003	10/31/2002	93	Complete
First Far Detector Super Mod Complete & Tested	L-1-7	3/15/2003	7/24/2002	234	Complete
Inner & Outer Conductors for First Production Horn Assembled	L-1-6	4/14/2003	2/5/2003	68	Complete
Target Service Building Shell Complete	L-2-18	9/30/2003	7/7/2003	85	
Near Plane Pre-assembly Complete	L-2-20	10/10/2003	12/17/2002	297	Complete
Far Detector Complete & Tested	L-1-8	4/25/2004	9/10/2003	228	
Beneficial Occupancy of Service Buildings at Fermilab	L-2-11	5/31/2004	12/12/2003	171	
Start Commissioning with Both Near and Far DAQ	L-2-21	8/30/2004	4/1/2004	151	
Complete Installation of Horn Power Supply	L-2-17	9/1/2004	9/18/2003	349	
MI Stub Installation Complete	L-2-15	3/11/2005	10/1/2004	161	
Near Detector Complete & Tested	L-2-14	3/31/2005	9/24/2004	188	
First Horn Installed	L-2-13	4/7/2005	5/25/2004	317	
Start Commissioning	L-1-9	9/1/2005	12/8/2004	267	
CD-4 Start Operations	L-0-3	9/30/2005	1/19/2005	254	End of Commissioning



NuMI Project Financial Status



Report Date	% Complete
March 2002	62% with $64M to go
September 2002	73% with $45M to go
March 2003 (PROJECTION)	*81% with $30M to go*

Expected Progress in 2003

- Far Detector: complete and taking physics quality atmospheric neutrino data
- Summer Installation in Main Injector enclosure—magnets, crane, instrumentation, and more
- Finish Service Buildings and Outfitting; progress on closeout of Tunnels and Halls
- Fall Installations begin at Target and MINOS sites
- Technical Component fabrication peak year
- ES&H Performance continuing to improve
- Planning for "readiness reviews" including SAD
- Beam studies in FMI and Booster underway

Some Potential Risks and Concerns

- Key Installation management positions must be filled by June 1
- Timely availability of trained technical staff
  - Competition with other activities at lab
  - Key positions, even when filled, may not have enough backup
  - Overall numbers still consistent with projections discussed with BD/PPD
  - Some installations do not start for over a year
- We need time in accelerator to install : at least 15 weeks
  - We have not been able to get any work done in tunnel since January
- We need time to commission our accelerator components and react/mitigate. (Lambertsons, Recycler shielding, beam studies)
- Finish making our water pumping system failsafe.

Conclusion

- We have made good installation progress since the December review
- We will be ready for the summer installation in the MI.
- Conventional Facility readiness will not be a significant problem and does not alter any of our current planning
- We must get on with installation of components to be sure we can mitigate any operational interferences between NuMI and the rest of the program. (CD4 is not in jeapordy though)
- We have intitated discussions on identifying key installation personnel some need to be on board in mid May. Availability of specific technicians and engineers for installation needs very careful control.
- We have not been able to make use of unexpected "1 week" downtimes in the program, but we must figure out how to do this
- We have a plan to manage work that will ensure we have adequate ESH controls amongst contractor, PPD, BD, and users during installation.